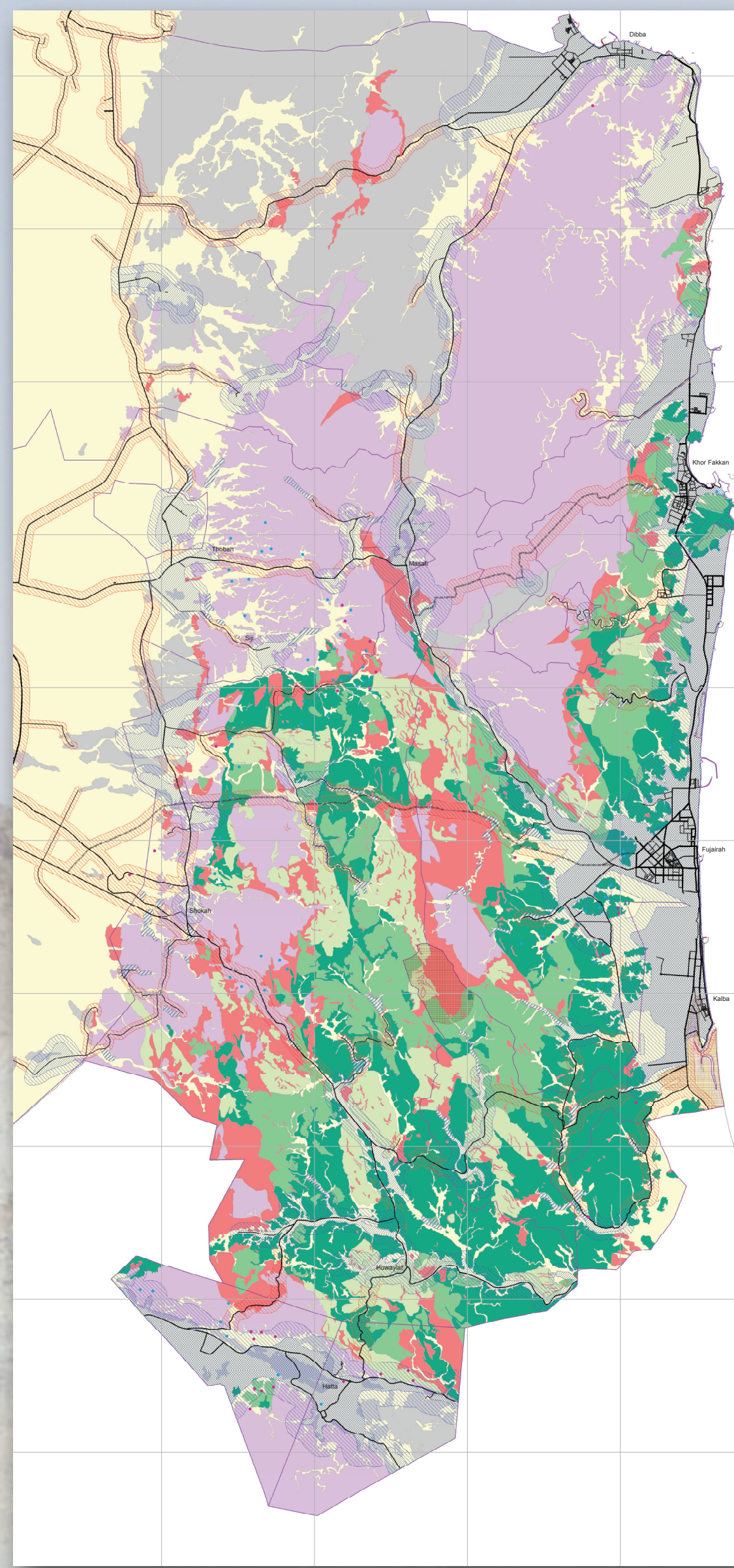




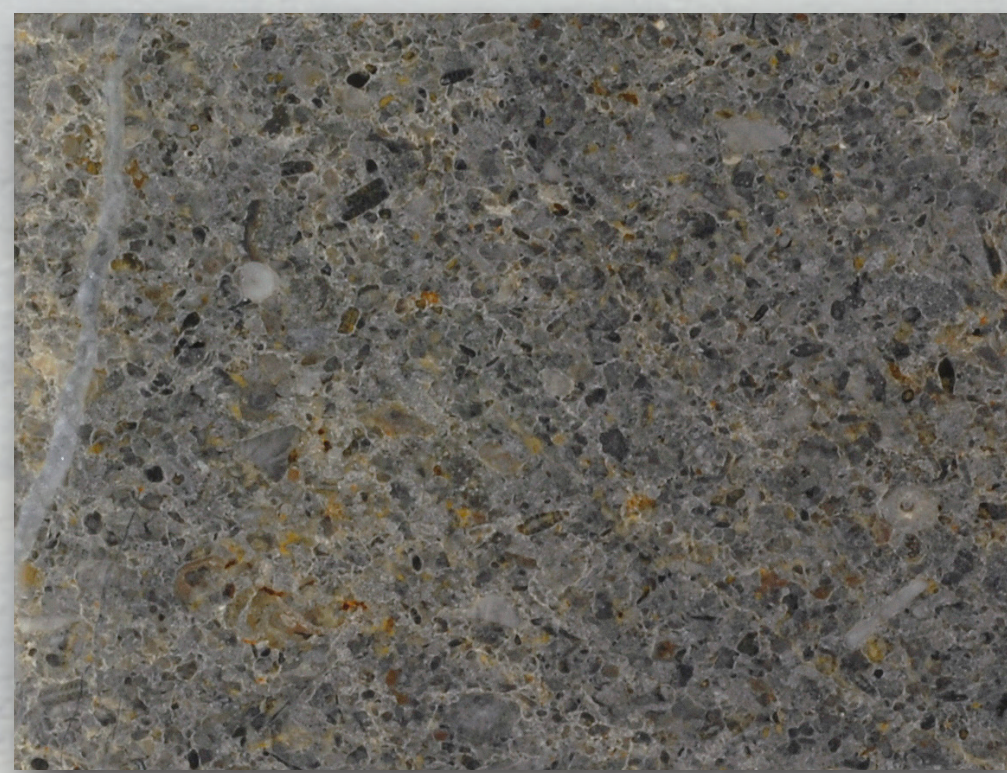
The Rock Resources of the Northern Emirates

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The United Arab Emirates (UAE) has vast resources of limestone and hard rock in the northern Emirates. These are currently exploited by quarrying companies to produce construction aggregate and raw material for the manufacture of cement, with a small amount being used to produce rock wool, dimension stone and mineral filler. The demand by industry in the UAE for higher value mineral products is currently met by imports but could be met by production from local rock resources. As part of the work funded by the UAE Ministry of Energy, the British Geological Survey (BGS) carried out studies (during 2008 to 2011) of the hard rock, dimension stone, and limestone and dolomite resources of the UAE.



Map of hardrock resources.



Polished tile of Dhera Limestone Formation, Ghub, Fujairah, UAE (size of tile, 10 cm across).



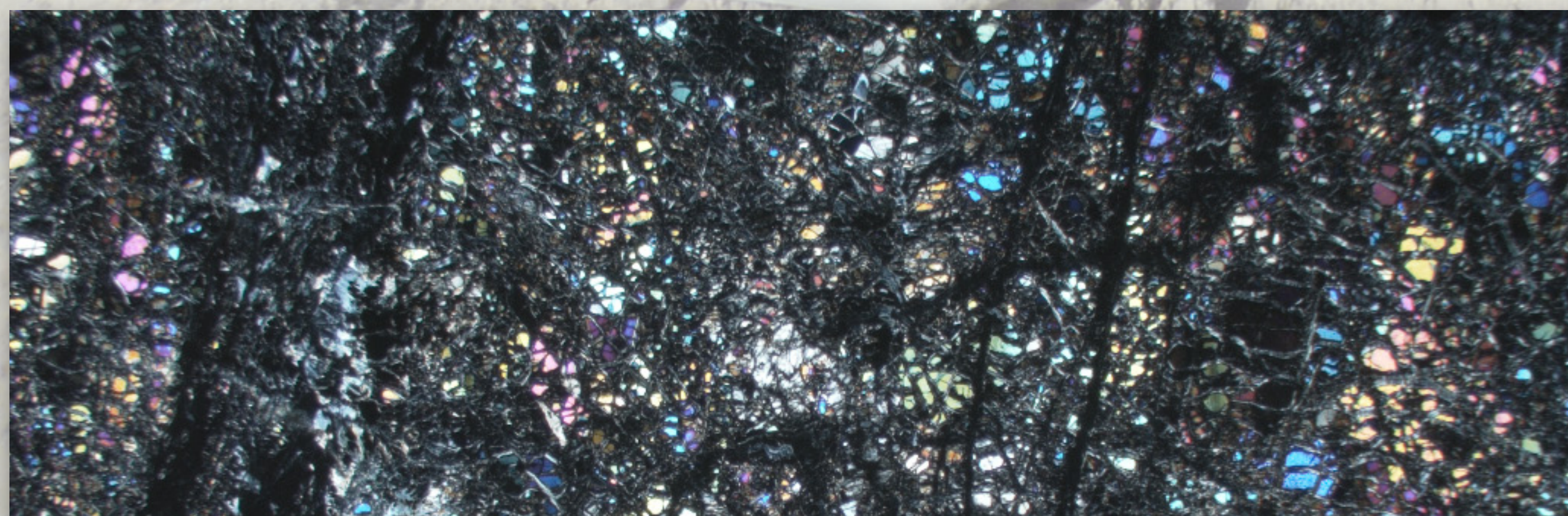
Manual polishing of marble slab at Kafesha Industrial Company, Al Quoz, Dubai, UAE.



Dimension stone in use at Madinat Mall, Jumeirah, Dubai, UAE.

Dimension stone resources

Dimension stone is natural stone that has been extracted and cut for use in wall cladding, floor tiles and structural components in modern tower blocks, hotels, offices, airports, shopping malls and private homes. A wide variety of rock types are used including igneous (granite, gabbro, porphyry, basalt and serpentine), metamorphic (marble, gneiss and slate) and sedimentary (sandstone, limestone and travertine). The UAE has a thriving dimension stone industry that uses stone imported from India, Saudi Arabia, Spain, China, Oman, Italy, Iran, Turkey, Greece and Pakistan. In 2008, the UAE imported over 200,000 tonnes of dimension stone valued at over US\$42 million. There is currently no significant production of dimension stone from quarries in the UAE. A study was carried out by the BGS to identify limestone and hard rock resources in the UAE that could be used for the production of dimension stone. In total 31 sites were assessed and samples collected for test work to assess their suitability. Each site was assessed to determine the presence of planes of weakness (bedding, faults, fractures and joints) that could affect the production of large blocks, as well as the accessibility and likelihood of quarrying being permitted. The samples were tested to determine their strength, water absorption, porosity and density, as well as their appearance when cut and polished. The twelve sites identified that met the assessment criteria occur in the Musandam 2 Formation, Dhera Limestone Formation, Jebel Qamar South Limestone Formation, Jebel Qamar North Limestone Formation, Fujairah Gabbro, Kalba Gabbro, Layered Gabbro and Harzburgite. This study has identified rock types with the potential to be used as dimension stone and many more locations could be suitable after local site investigation.



View of Harzburgite (Masafi, Ras al Khaimah, UAE) through a microscope showing colourful crystals of olivine cut through by serpentine (size of view, 8 mm across).

Hard rock resources

There is a well established quarrying industry in the Hajar Mountains of the northern and eastern UAE that produces a range of rock products (mostly construction aggregate) from the UAE-Oman ophiolite rocks (mainly gabbro with ultramafic rocks including harzburgite and dunite). Some quarries are located in areas where the rock resources are of poor quality and/or the reserves are limited. A study was carried out by the BGS to make the geological information, available in the geological maps and reports published by the BGS in 2006, more accessible to the quarrying industry. Over 100 quarries were surveyed in the Fujairah, Ras al Khaimah, Ajman, Dubai and Sharjah emirates and rocks samples were collected and tested. A new map was produced that classifies the hard rock resources of the ophiolite according to their suitability for use as construction aggregate. Five categories were used in the classification scheme comprising: Highest grade gabbro aggregate; Good gabbro aggregate; Good gabbro aggregate mixed with unsuitable rocks; Unsuitable rocks; and Peridotite serpentinite good aggregate. Unsuitable rocks include basalt, wehrlite and rocks generally near the major fault zones that are intensely altered. The map also includes buffer zones to indicate areas where quarrying may have a detrimental impact on local communities or the road network. The aggregate suitability map could be used for planning purposes such as the expansion of existing quarries and the location of new quarries. It will greatly reduce the quarrying of poor quality rock and improve the standard of construction material produced in the future.



Construction aggregate quarry working gabbro near Fujairah, UAE.



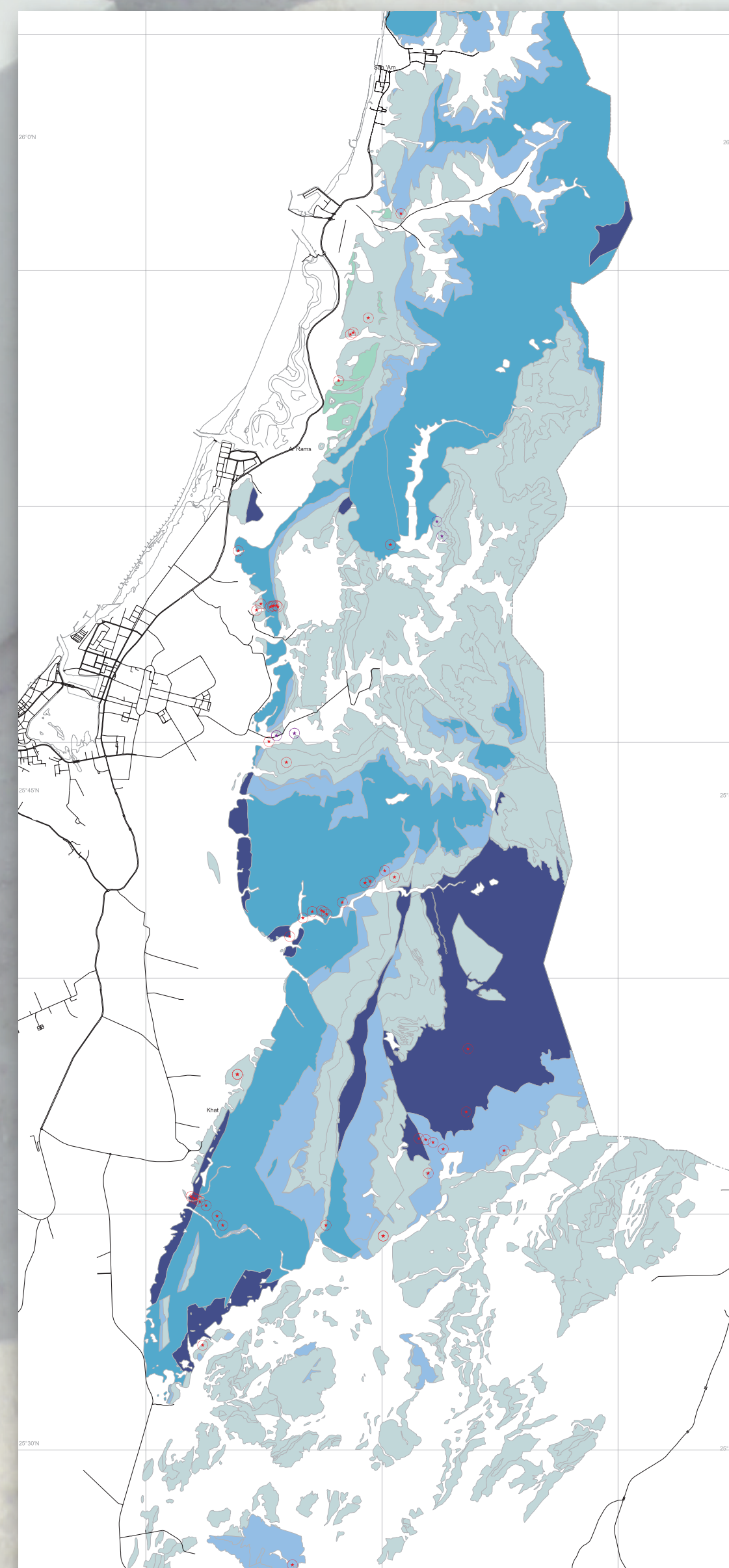
Production of rock wool at the factory in Fujairah, UAE.



Construction aggregate quarry working gabbro near Siji, Fujairah, UAE.

High purity limestone and dolomite resources

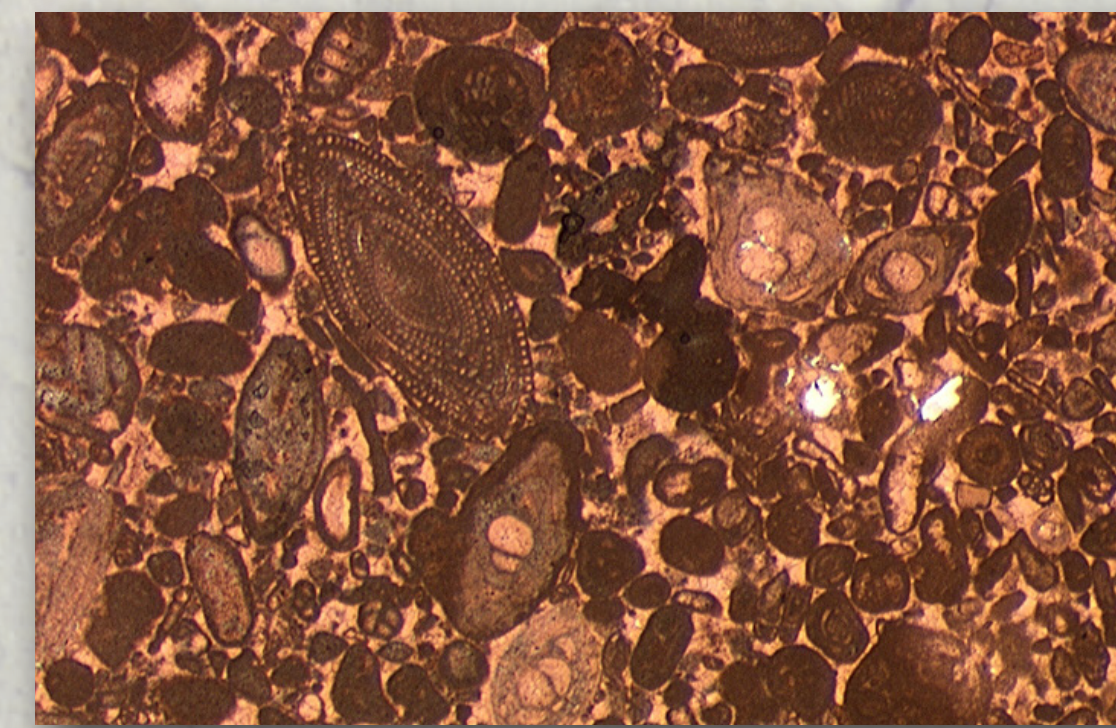
Limestone and dolomite have many high value industrial applications including the manufacture of paint, paper, plastic, pharmaceuticals, glass, ceramics, food supplements, and chemicals. Currently, the limestone and dolomite resources of the UAE are mainly worked to produce low value construction aggregate, with little production of high-purity products. In 2008 the UAE imported over 200 000 tonnes of high purity limestone and dolomite valued at over US\$20 million to meet industrial demand. A study was carried out by the BGS to assess the potential of the resources in the UAE to produce high-purity limestone and dolomite. Nearly 250 samples of limestone and dolomite were collected from the northern emirates and tested to determine their chemical composition. A new map was produced that classifies the limestone resources of the UAE according to their purity as industrial-grade limestone (calcium carbonate). Five categories were used in the classification scheme comprising: Very high purity; High purity; Medium purity; Low purity; and Impure. The purity is based on the calcium oxide (CaO), magnesium oxide (MgO), silica (SiO₂) and iron (Fe₂O₃) content of the limestone. Localities of high purity dolomite (calcium magnesium carbonate) are also shown on the resource map. Sixty five localities of high purity limestone and 6 localities of high purity dolomite were identified. This study has shown that the UAE has resources of high purity limestone and dolomite that could be used to produce valuable industrial products. The development of these resources has the potential to make a substantial contribution to the economic diversification of the UAE economy.



Map of limestone resources.



High-purity limestone is used as a filler in paint by National Paints, Sharjah, UAE.



View of Rus Formation limestone (Jebel Hafit, Al Ain, UAE) through a microscope showing microfossils (size of view, 8 mm across).



Inspection of Musandam 2 Formation limestone, Wadi Naqab, Ras al Khaimah, UAE.